A RE-CONSIDERATION OF THE GALLEY HILL SKELETON

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By K. P. OAKLEY *and* M. F. ASHLEY MONTAGU

(*With Plate 4*)

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SYNOPSIS

The evidence for the antiquity of the human skeleton found 8 ft. below the surface in gravels of the 100-ft. terrace (Middle Pleistocene) at Galley Hill, Swanscombe, Kent, in 1888 is re-examined. Morphologically the skull and mandible show no features which cannot be matched in the contemporary population of Britain. The probability that the skeleton was interred in comparatively recent times is suggested by the geological evidence, and has been confirmed by application of the fluorine test.

INTRODUCTION

LATE in September 1888 a workman, Jack Allsop, unearthed a human skeleton 8 ft. below the surface when digging gravel in a pit at Galley Hill, on the brow of the 100-ft. terrace overlooking the Thames in the parish of Swanscombe, Kent (Figs. 1 and 2). Matthew Heys, headmaster of the elementary school which adjoins the pit, was brought in to see the skull and other bones protruding from the gravel face shortly after they had been exposed, but school duties prevented him from taking action. It happened that shortly afterwards an amateur archaeologist, Robert Elliott, a printer by trade, from Camberwell, visited the pit and removed the bones, which were in a fragmentary condition. A few days later he took them to London to the palaeontologist, E. T. Newton, who offered to mend and study the material, but Elliott said that he would like to work up the subject and publish his own account of the discovery. However, he was unable to find the necessary leisure and after a lapse of six years Frank Corner, medical practitioner of Poplar, persuaded him to hand the material to Newton for description. In the early years of the present century Corner bought the Galley Hill skeleton from Elliott for £100,[1] and in 1912 deposited the remains on loan in the Department of Geology, British Museum. Here they remained until January 1948, when they were withdrawn by Corner's widow, Mrs. D. H. Pearson, and at the present time they are packed in the store-room of Messrs. Puttick & Simpson, London. Small samples of the bones and of the deposits in which they lay embedded are preserved in the Elliott Collection in the Department of Geology.

[1] We are informed by one of Robert Elliott's sons (Mr. Arthur Galley Swanscombe Elliott) that Corner thus enabled his father to settle a debt.

HISTORY OF INVESTIGATION

In 1895 Newton presented to the Geological Society of London a detailed account of the skeleton and of the evidence for its antiquity. He pointed out that the skull appeared to represent an extreme form of the Long Barrow race, which typically was Neolithic. But having weighed the evidence he found no reason for disbelieving the statements of Heys and Elliott that the gravel overlying the bones was undisturbed, and in that case the remains were Palaeolithic. However, he phrased his initial conclusions with caution. For instance, referring to his inspection of the site in 1894 he wrote (1895: 520): '. . . the gravel itself, which contained the bones, has been removed, and the present face of the pit is about 10 feet from the exact spot. This change, although slight, is quite sufficient to prevent verification of the undisturbed condition of the gravel overlying the skeleton which, under the circumstances, is so desirable. . . .' But later he said: 'I am not aware of any human bones which have a greater claim than these to be accepted as having been coeval with the Mammoth' (Newton, 1898: 258).

Most geologists and prehistorians have always been sceptical about the alleged antiquity of the Galley Hill skeleton. In the discussion which followed the reading of the paper to the Geological Society (Newton, 1895: 525–7), Sir John Evans said that 'what weighed most with him, and led him to doubt whether the bones were of the same age as the gravels, was the fact that nearly the whole skeleton, including the lower jaw and clavicle, had been preserved'. This, he said, 'was suggestive of an interment'. Boyd Dawkins said that in his opinion 'the skeleton was probably the result of interment in the Palaeolithic gravels at a later time'. He suggested that it should 'be placed to a suspense account'. Sollas 'regretted that the evidence for the absence of interment was not more perfect'.

Many physical anthropologists, on the other hand, apparently impressed by the cogency of Newton's case for the Palaeolithic age of the skeleton, have been inclined to stress such features in the skull as might be interpreted as primitive. Klaatsch (1910) considered that the skull agreed closely with the Combe-Capelle and Brünn (Brno) skulls of Upper Palaeolithic age, the former of which he described as the type of a new sub-species, *Homo aurignacensis hauseri*. In 1911 Sir Arthur Keith was of a similar opinion, but he proposed that the term 'Galley Hill race' should be used to cover all variants of the type. He considered that the Galley Hill specimen was the oldest known representative of the race, which he said had a very long range in time, being 'still represented in the modern population of Britain' (Keith, 1911: 43; see also Keith, 1948: 265).

In 1913 Dr. W. H. L. Duckworth reviewed the evidence for the antiquity of the Galley Hill skeleton and concluded that it was almost certainly a burial, possibly of comparatively recent date. In succeeding years Keith (1915: 184–5) accepted it as a burial, but he maintained that it was interred from a Lower Palaeolithic (Chellean) land surface.

If the geological evidence had indicated an *Upper* Palaeolithic age for the Galley Hill burial, there might have been less scepticism about its authenticity, but at any rate up to a decade ago few anthropologists were prepared to find that modern man dated back to Lower Palaeolithic times. In later years Keith said that he had become 'more and more sceptical of the geological evidence which assigns a high antiquity to modern types such as are represented by Galley Hill man . . .' (Keith, 1930: 30).

However, in 1935–6 Mr. A. T. Marston discovered part of a human cranium at a depth of 24 ft. in the 100-ft. terrace gravels of Barnfield pit, Swanscombe, not far from Galley Hill (Fig. 1). There was no doubt that this was a fossil skull of Lower Palaeolithic (Acheulian) age. When Professor Le Gros Clark and Dr. Morant (1938) demonstrated that so far as it was preserved it showed no features which distinguished it from modern man, interest in the Galley Hill skeleton naturally revived. At any rate there appeared to be less reason for doubting the antiquity of the latter merely on the score of its modern morphology. Those who had examined the bones, and who were familiar with the geological background of Elliott's find, remained sceptical, but one of the present authors, in common with many others who had to rely solely on published evidence, from then onwards provisionally accepted the Galley Hill skeleton as of Lower Palaeolithic age (Montagu, 1945: 101–3). The current view in the U.S.A. regarding the alleged antiquity of Galley Hill man is that 'a better case can now be advanced than ever before' (Hooton, 1947: 365; see also Coon, 1939: 21).

The possibility of settling debated questions such as this by application of the fluorine test has been under consideration for some years at the British Museum and the present review of the Galley Hill evidence is in fact largely the outcome of a general investigation of the mineral dating of bones which is being undertaken by one of the authors (K. P. O.) in co-operation with staff of the Department of the Government Chemist, London.

In the summer of 1948 the other author (M. F. A. M.) visited England on a grant from the Viking Fund which enabled him to undertake extensive field studies in the Galley Hill–Swanscombe region. While in London he took the opportunity of making a thorough examination of the Galley Hill skeleton in which he had long been interested. When the authors met at midsummer they found that they had independently reached similar conclusions with regard to the probable dating of the skeleton and at the request of the Keeper of Geology they have prepared a joint report on their findings. One author (K. P. O.) has prepared the introductory sections, the account of the geology, and of the fluorine dating: the other (M. F. A. M.) the section on morphology. The sections on conditions of occurrence of the skeleton and on other burials have been prepared jointly. It should be set on record that the conclusions from morphology were reached before the results of the fluorine test were available.

SITE OF DISCOVERY: GEOLOGICAL BACKGROUND

The skeleton was discovered during the removal of gravel overburden from the Chalk, which during the eighties was being quarried from the north-facing bluff of Galley Hill by Messrs. J. B. White, cement manufacturers. This pit had been in use for nearly fifty years and at the time of the discovery the gravels which cap the hill at about 90 ft. above sea-level had already been cleared back to within a few yards of the London road (Figs. 2, 3). Practically all the Chalk thus bared has since been extracted down to the lower limit of working (about 20 ft. above sea-level) and the pit is now disused (Pl. 4 A, fig. 2), but on the south side of the pit, immediately west

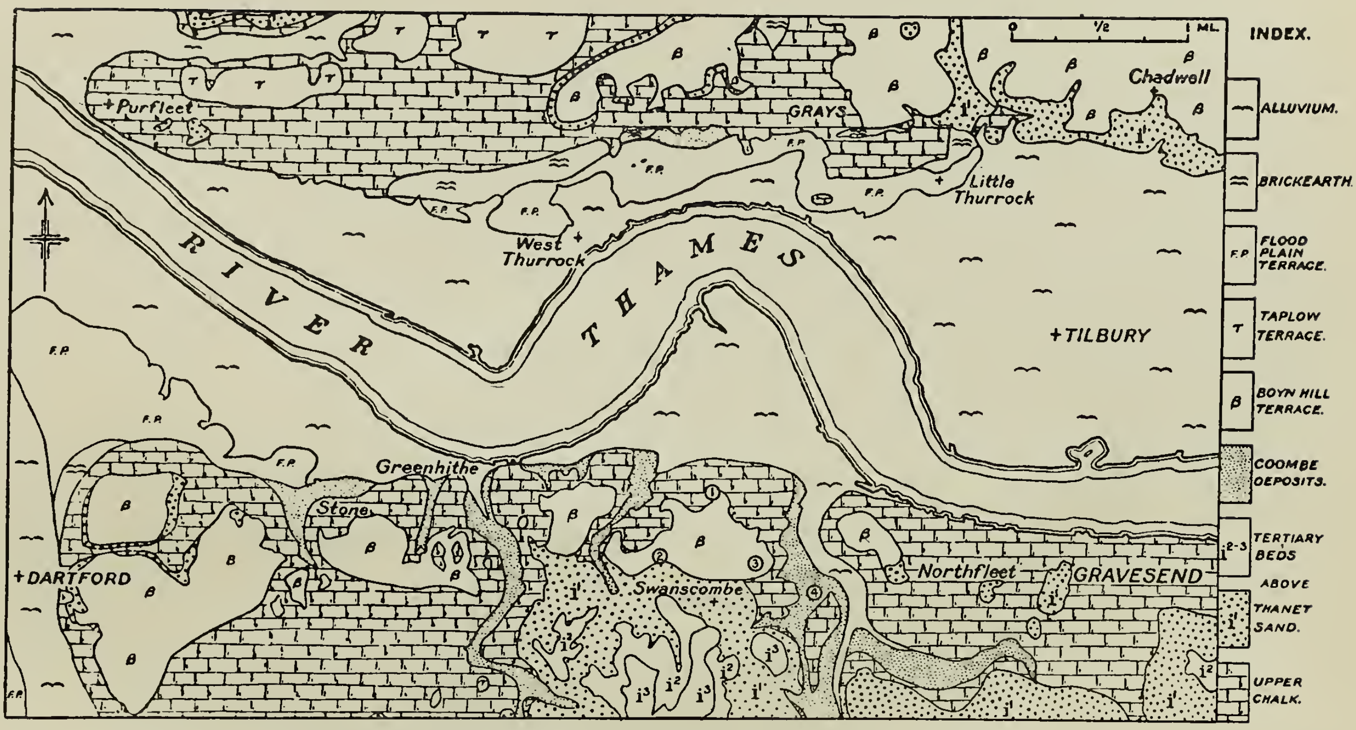

FIG. 1. Geological map of part of the Lower Thames area, showing the localities referred to in the text:

1 = Galley Hill pit (N), 2 = Barnfield pit, 3 = Rickson's pit, 4 = Baker's Hole (Ebbsfleet).

(Reproduced from Dewey 1932, with slight modification, by permission of the Council of the Geological Society of London.)

of the Galley Hill school and adjoining the London road, there still remains a narrow shelf of unworked Chalk from which it is possible to reach an overgrown section of the gravels close to the site where the skeleton was found. This is the face which was photographed by Clement Reid about 1894 (Fig. 3). In the autumn of 1948 Mr. A. J. Thomas, who until recently was Deputy Manager of the Swanscombe Cement Works (Associated Portland Cement Manufacturers Ltd.), which occupy the

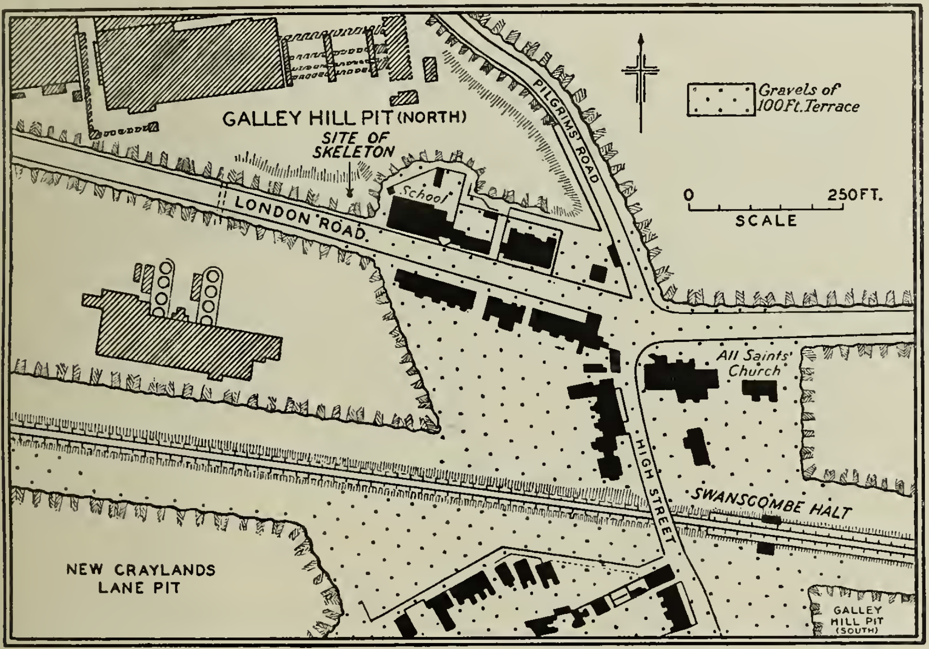

FIG. 2. Map of Galley Hill, Swanscombe, showing present distribution of 100-ft. terrace gravels on the Chalk, and the site where the human skeleton was found in 1888.

(Based on 25-inch Ordnance Survey Map, 1939 revision, and on 6-inch Geological Survey Map 1920.)

floor of this disused pit, kindly arranged to have part of the section cleared so that the deposits could be re-examined (Pl. 4 B).

The gravels which cap the Chalk on Galley Hill are part of a broad dissected sheet of stratified fluviatile gravels, sands, and loams which belong to the so-called Boyn Hill, or 100-ft. terrace of the Lower Thames (Fig. 1). These deposits attain a maximum thickness of about 40 ft. in the region of Barnfield pit nearly half a mile to the south-west, and they evidently lie within a broad asymmetric channel (Fig. 4) cut partly in Thanet Sand, but mainly in Chalk, trending west to east, and with its deepest portion cut to about 75 ft. O.D. This channel was eroded and then silted-up by the Thames when the river meandered far to the south of its present course, and when the land stood more than 50 ft. lower in relation to sea-level than at the present day. The Chalk floor of the channel rises gently northwards from Barnfield pit, and at Galley Hill, where it is 83 to 90 ft. above O.D., it is covered by only 6–12 ft. of deposits. Undisturbed fluviatile layers have been preserved only over a very limited area at this site, where they are beginning to wedge out against the northern bank of the old channel. Where thin, they have been partly, or even entirely at some points, displaced by

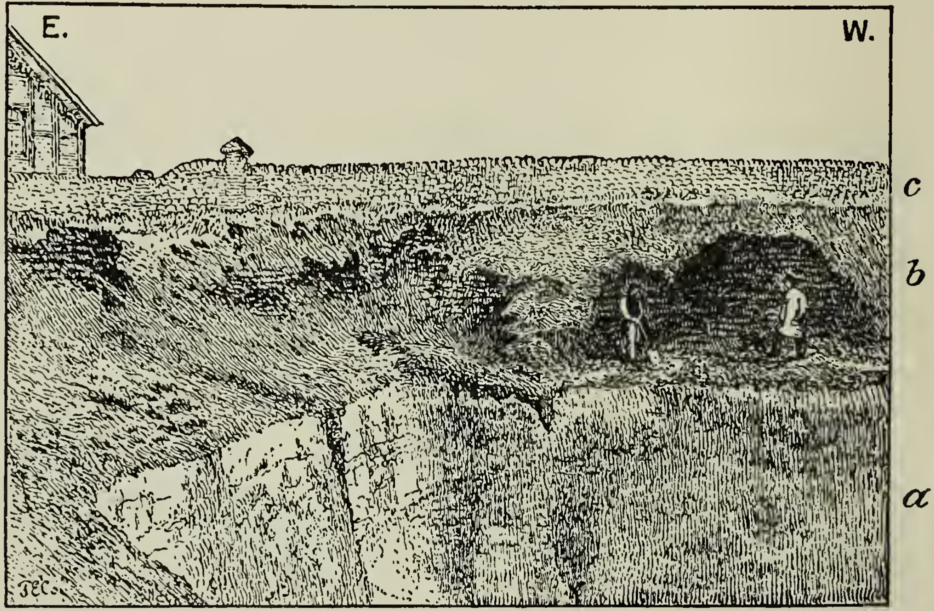

FIG. 3. The Galley Hill pit (North) about 1894. Drawing of the SE. corner of the pit, based on photographs by Clement Reid and J. W. Reed.

a = Chalk, *b* = gravel, *c* = wall flanking London road. The right-hand figure stands on the site where the skeleton was found.

(Reproduced from E. T. Newton, 1895, by permission of the Council of the Geological Society of London.)

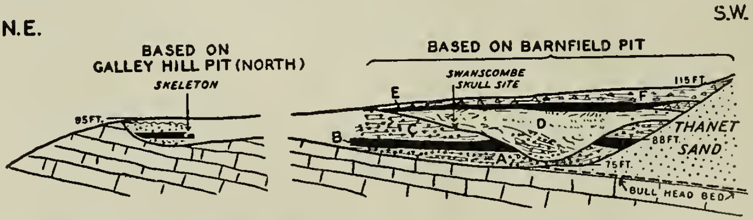

FIG. 4. Diagrammatic section across the 100-ft. terrace at Swanscombe, showing relative positions of deposits in the Galley Hill and Barnfield pits.

A = Lower Gravel, *B* = Lower Loam, *C* = Lower Middle Gravel, *D* = Upper Middle Gravel and Sand, *E* = Upper Loam, *F* = Upper Gravel.

Not drawn to scale, but figures indicate heights above Ordnance Datum at key points.

(Barnfield pit based on Dines, 1938.)

unstratified clayey gravel and loam, evidently solifluxion sludge formed under periglacial conditions when the river had abandoned the channel and was eroding its bed at lower levels farther north.

In the critical section west of the school buildings the gravels are sandy and nearly

10 ft. thick (Pl. 4 B). Although disturbed to varying depths by solifluxion and solution piping, they are seen at some points to be well stratified throughout the greater part of their thickness, and are clearly of fluviatile origin. They become thinner, and consequently more confused by solifluxion, to the east and to the west, and die out altogether to the north; so evidently they occupy an embayment in the northern margin of the Swanscombe channel. The section on the far side of the pit, only about 100 yards to the north-east, shows no remnant of these fluviatile layers, only solifluxion gravels with pockets of subaerial loam, resting directly on Chalk.

Although now truncated by quarries on the south side of the London road, the fluviatile gravels of Galley Hill were originally continuous southwards with those exposed in the New Craylands Lane and Barnfield pits (Dines, 1938). In the Barnfield pit (Figs. 1, 4), which is generally regarded as the type-section of the 100-ft. terrace of the Lower Thames, there are four main divisions: Lower Gravel, Lower Loam, Middle Gravels (and Sands), and Upper Loam and Gravel. The Swanscombe skull (*Homo* sp. cf. *sapiens*) occurred at 94 ft. above O.D. in the Middle Gravels. It has been suggested that the Galley Hill skeleton came from a layer corresponding to the Lower Gravel or the Lower Loam (Keith, 1915: 184; cf. Rutot, 1910: 241–3). It is worth considering this possibility, if only as a means of presenting a fuller picture of the deposits with which investigators of the human remains are concerned.

The skeleton was found 2–3 ft. above the base of the gravels. From the published data and from measurements taken in 1948, it is estimated that it was approximately 86 ft. above O.D., which is close to the maximum altitude attained by the Lower Gravel in the region of Barnfield pit. When one considers, however, the way in which the fluviatile deposits of the 100-ft. terrace were laid down, by a meandering, perhaps at times braided, river which was continually carving out new channels and then aggrading them, it becomes obvious that deposits at the same level are not necessarily of the same age. This principle is strikingly illustrated by the section in the Barnfield pit (Fig. 4) which shows the Upper Middle Gravels occupying a channel cut into the underlying deposits down to the base of the Lower Gravel.

It is nevertheless well established that the Lower Gravel and the Middle Gravels are distinct and persistent units in the 100-ft. terrace of the Swanscombe district, probably in origin separated by a considerable interval of time. The Lower Loam, which in Barnfield pit caps the Lower Gravel, shows the weathering characteristic of a land-surface. The two gravels are recognizable, although not separated by an intervening bed of loam, in Rickson's pit, ¾ mile to the south-east (Fig. 1). They are distinguished by totally different Palaeolithic industries. The Lower Gravel contains numerous Early Clactonian flakes and cores (formerly classified as Strepyan or Pre-Chellean) but no bifacial hand-axes. The Lower Loam is archaeologically sterile but clearly belongs to the Lower Gravel stage. The Middle Gravels are rich in unworn Acheulian hand-axes (*bifaces*), including types which were at one time classed as Chellean. It is therefore quite legitimate to inquire whether the Galley Hill gravels belong to the Lower Gravel stage or to the Middle Gravels stage, or, indeed, whether they include condensed representatives of both.

From Elliott's description of the deposits visible in the critical section in 1888, confirmed by Heys's letter to Keith (1915: 181), it appears that the skeleton was partly contained by a seam of loam 2 ft. 6 in. above the base of the gravel. The same or a similar seam (*vide infra*) was visible in 1894 after the section had been worked back 10 ft.; but none was encountered when the section was reopened in 1948. The Lower Middle Gravels in Barnfield pit are covered by an impersistent layer of loamy silt (Marston, 1942: 106), and the Middle Gravels of Rickson's pit also include lenticular seams of loam or clay (Dewey, 1932: 45). There is no evidence to support the suggestion that the seam recorded by Elliott corresponded to the Barnfield Lower Loam rather than to one of the loamy intercalations in the Middle Gravels. Judging from the fact that Elliott's collection from Galley Hill consists almost entirely of Acheulian hand-axes (mainly 'points'), it seems unlikely that the Lower Gravel is represented there at all. Early Clactonian artifacts occur only sparingly. A slightly rolled conical core of that industry was turned out at about 3 ft. above the base of the gravels in the recent excavation, but such specimens could be residue of Lower Gravel eroded from this part of the channel in Middle Gravel times.

On balance the available evidence suggests that the deposits in which the skeleton appeared to lie belong to the Middle Gravel stage, but it must be borne in mind that this in itself represents a lengthy period of time. As already indicated, these deposits are the alluvia of a river which was continually shifting its course and whose volume was liable to considerable variation; swollen by rains and in full spate it would scour channels through older alluvium, and then as the volume slackened these would be filled with fresh deposits. Thus the gravels exposed in different pits at the same general level are likely to vary in age. This is borne out by differences between the assemblages of Acheulian implements from the various exposures of Middle Gravels in the Swanscombe region. Although it is possible that the gravels in the Galley Hill pit are slightly younger than the Middle Gravels in some other sections of the 100-ft. terrace, there is no evidence to suggest that in time of formation they fell outside the limits of the main Acheulian interglacial (Middle Pleistocene). So far as can be ascertained the Galley Hill collection is lacking in twisted ovates and tortoise-cores, types characteristic of the traditions which prevailed during the close of that period, when the Thames was intermittently cutting its bed to lower levels and the climate was becoming periglacial. The even, horizontal bedding of the Galley Hill gravels is indicative of normal fluviatile origin and precludes the possibility that they have been redeposited in a hollow of the terrace by freshets during the melting of frozen ground-water in Upper Pleistocene times. They are river deposits forming an integral part of the 100-ft. terrace, so that if the Galley Hill skeleton is accepted as indigenous, and not a later burial, it would have to be considered as broadly contemporary with the Swanscombe skull.

The dating of the Galley Hill skeleton as Upper Pleistocene by some authorities (e.g. Paterson, 1940: 49, who refers it to a new subspecies *Homo sapiens londiniensis*), is presumably either based on skull morphology, which Professor Montagu shows below to be fallacious, or on the typologically advanced appearance of the supposedly associated hand-axes, which could, however, be accounted for by mere precocity on the part of some of the Acheulian knappers. From the geological evidence it is known that the Thames did not re-aggrade its bed to the 100-ft. level after the downcutting which followed the Middle Gravels stage. Whatever system of classification of Thames terraces is followed, there seems to be no escape from the conclusion that the fluviatile gravels at Galley Hill belong to the same physiographic cycle as those from which the Swanscombe skull was recovered, now generally classed as Middle Pleistocene.

CONDITIONS OF OCCURRENCE

Robert Elliott and Matthew Heys saw part of the skeleton *in situ* before removal. Heys, writing in 1895, seven years after the discovery, said: 'I was struck by the undisturbed condition of the gravel in which it was embedded; it seemed as though gravel and skull were deposited at the same time.' Elliott in a letter to E. T. Newton in 1894 stated the facts, so far as he could remember, as to the conditions under which they were found. The greater part of the letter is quoted by Newton (1895: 518). When Elliott entered the pit in September 1888 on one of his fortnightly visits in search of flint implements, the workman, Jack Allsop, informed him that he had 'found a skull under the gravel' and then 'produced it in several pieces from the base of a pillar of laminated clay and sand, where he had hidden it'. When asked where the rest of the bones were, Allsop 'pointed to the section opposite this pillar, and a few feet away from it, and told me that he had left the other bones undisturbed, for me to see; and there, sure enough, about 2 feet from the top of the Chalk, and 8 feet from the top of the gravel, portions of bone were projecting from a matrix of clayey loam and sand'. He told Elliott that 'several men employed at the works, the master of the neighbouring school, and a clergyman, had seen the skull'. Elliott's letter continued as follows:

'The section of gravel was 10 or 11 feet thick, and extended for a considerable distance along the south and east end of the pit; several pot-holes or pipes running from it, deep into the Chalk. I carefully examined the section on either side of the remains, for some distance, drawing the attention of my son Richard, who was with me, and of Jack Allsop, to it. It presented an unbroken face of gravel, stratified horizontally in bands of sand, small shingle, gravel, and lower down beds of clay and clayey loam, with occasional stones in it—and it was in and below this that the remains were found. We carefully looked for any signs of the section being disturbed, but failed: the stratification being unbroken, and much the same as the section in the angle of the pit remaining to this day, but it was then clear and not covered by rubbish as it is now in places, all the "callow" and loam at the top being at that time removed to allow the gravel being got at.'

It appears that the bones were mainly embedded in loam, but that they projected down into the underlying sandy gravel. Heys (in Keith, 1925: 255) said that the underneath part of the skull was 'resting on a sandy gravel'. In an unpublished part of his letter to Newton, Elliott says: 'I should tell you that I have preserved a small box of sand in which the remains were found and shaken out of the bones.' Two boxes were eventually deposited in the Department of Geology, British Museum (Nat. Hist.). One of these, presumably the box referred to in the letter, contains coarse reddish-yellow quartz sand with numerous small flint pebbles mostly less than 10 mm. in diameter. The lime-content and clay fraction of this sample are negligible. Enclosed in the box is a manuscript label signed R. Elliott: 'Sample of Gravel in which I found the Remains at Galley Hill—2 ft. from Bull Head of Chalk.' (The Bull Head bed is a band of large, green-coated flint nodules, sometimes partly embedded in the Chalk, which in this region forms the base of the Thanet Sand; but Elliott appears to be using the term as synonymous with 'eroded surface of Chalk'.) When the section was reopened in 1948 several feet of stratified sandy gravel, matching the sample in the box precisely, were seen to rest on the Chalk (Pl. 4 B). The second box contains lumps of hard loam of pale reddish-brown colour, with the following manuscript label: 'Clay from Galley Hill. Dug out by the late Mr Topley, Mr Newton, Dr Corner, and myself, June 12th, 1894. R. Elliott.' There is a note in the corner of the label: '*3 ft.* B.H.' (presumably 3 ft. above Bull Head). This sample was evidently regarded as identical with the 'clayey' deposit in which the human limb bones had been found seven years previously. It is not a clay, but a coarse silty loam containing scattered quartz grains and an occasional fragment of weathered flint, and in the dry state it is very porous in texture. The rather ill-sorted appearance of the deposit under a lens is reminiscent of some subaerial brickearths, but this is probably an effect of the loss of a limy matrix. Mr. I. W. Cornwall kindly examined it for us in the Geochronology Laboratory, London University Institute of Archaeology. He reports that it has a pH of 6·8 (confirming our impression of complete decalcification), and further that on mechanical analysis it shows the following composition (summarized): sand 19 per cent.; silt 66 per cent.; clay 15 per cent. Some of the sand grains, which are well lustred as in a river sand, exceed 1 mm. diameter. The deposit was evidently waterlaid, but Mr. Cornwall points out that the unusually high proportion of the 'silt-grade' (0·008–0·1 mm.) suggests that it may contain redeposited loessic material.

The finding of a human skeleton embedded in two distinct types of matrix (silty loam and clean gravelly sand) is suggestive of artificial burial. There is, however, a more important consideration which supports this contention. The occurrence of articulated human bones in the Galley Hill deposits would be less surprising if fossil animal remains had been common at the same site, but in spite of the large quantities of gravel removed from the pit no fossil bones have been recorded there. The equivalent gravels in Barnfield and Rickson's pits have yielded quantities of contemporary animal remains (but only very rarely have two or more bones of an individual animal occurred in juxtaposition, even of abundant species such as the fallow deer *Dama clactoniana*). Excavation of about 80 cubic yards of Middle Gravels in Barnfield pit during the summer of 1948 produced over one hundred fragments of bone. The difference in this respect between the deposits in the Galley Hill pit and those in the Barnfield pit is readily explained, but the explanation is not reassuring from the point of view of substantiating the claim that the human skeleton from the former is indigenous. Whereas the Barnfield gravel, sands, and loams are so placed that they have largely escaped decalcification by percolating water, those at Galley Hill have been almost completely decalcified. It might be argued, of course, that the Galley Hill skeleton was protected from the action of percolating water by an impermeable clay matrix, but we have the evidence of the samples preserved by Elliott, which indicates clearly enough that the bones were contained in a permeable deposit. This point does not appear to have been considered by previous investigators, but indigenous bones could scarcely have survived since Middle Pleistocene times in a porous layer within gravels which have undergone complete decalcification. One must conclude, therefore, that the bones were introduced after the deposits had been decalcified.

Some authorities have stated that the preservation of the bones accords with that of other bones from the Pleistocene deposits of the Swanscombe region; but this is not true. The bones were soft at the time of their extraction, and after drying in the air were treated with 'gelatine' and later dipped in preservative solution (Newton, 1895: 519). These treatments have given their superficial surfaces an almost purplish hue, which at first glance gives the appearance of considerable antiquity. However, where the bone has been broken after being 'dipped' the colour is the same as that of the other bones, pale greyish-beige, as in bones of known Holocene age. The bones are light in weight, quite unmineralized, and scarcely different in appearance from those of comparatively recent domestic animals the bones of which one may pick up from the surface in the vicinity of Galley Hill. Although fossil bones of a pale beige colour are found in some Pleistocene brickearths, they are generally distinguished by their greater density or more compact texture. The characteristic fossil bones in the Pleistocene gravels and loams of the Swanscombe region have quite a different appearance, being stained yellowish or reddish brown, and usually showing dendritic stains of manganese oxide.

Newton rejected the possibility that the skeleton had been let down from the surface in a solution-pipe, on the grounds that the cleared area of Chalk showed no trace of a pot-hole immediately below the spot where the bones had been found. Perhaps rather more conclusive as regards this question are Elliott's observations, confirmed by Heys (Keith, 1925: 255), which imply that the containing deposits had the appearance of horizontal beds.

Newton dismissed the other important possibility, that the skeleton was the result of comparatively recent interment, for reasons which are now seen to be inadequate. His whole case rested on the fact that Heys and Elliott detected no signs of disturbance in the overlying gravel; but by the time that they saw the remnants of the skeleton sticking out of the face, it is probable that the bulk of any evidence of burial had already been destroyed by the gravel digger. From our experience of sections at Galley Hill we suggest that the deposits may in any case have been of such a nature that traces of disturbance due to burial would have been obscure (cf. Pl. 4 B). McKenny Hughes (1912: 187) has shown how easily traces of interment are obliterated in Pleistocene deposits; and more than one experienced geologist on first glancing at a section has mistaken settled layers of tipped gravel for natural strata.

Newton argued that simple graves are rarely, if ever, as deep as 8 ft. However, without knowing the precise nature and sequence of the superincumbent beds or the detailed contour of the ground before the gravel was stripped of 'callow', it is by no means certain that the only surface from which interment could have been carried out was as much as 8 ft. above the skeleton. Even if it were certain that the present surface was the only one from which it could have been buried, a depth of 8 ft. would not rule out interment. Professor D. M. S. Watson recovered the skeleton of a modern type of ox 8 ft. below the surface of Pleistocene gravels in a pit near by, in Milton Street, Swanscombe (Sutcliffe, 1913: 16). But is it not more likely that the Galley Hill skeleton represents an interment of Upper Palaeolithic age, antedating, say, only part of the overlying gravel (the top part might have been a Pleistocene solifluxion gravel)? If the skeleton were indigenous to the stratum in which it was found it would be of Acheulian age; but once it is admitted to be an interment there remains no vestige of dating evidence in the record of its occurrence. On the evidence considered so far, it could date from *any* period subsequent to the formation of the containing deposit.

TRACES OF OTHER BURIALS

About 1910 Sir Arthur Keith's attention was called to fragments of another human skeleton which had been found in the gravels of the Galley Hill pit many years earlier—in 1884. According to the recollection of Mr. W. H. Steadman, who had been assistant-master in the Galley Hill school at the time, the bones were found at a depth of about 5 ft. below the surface. When Keith was shown the skull, he pronounced it to be of the same type as that of the 'first' Galley Hill skeleton, but he noted that the bones were thinner and whiter, and his final conclusion was that: 'The evidence on the whole is decidedly against the probability of the second Galley Hill man being of the age of the 100-ft. terrace' (Keith, 1911: 43). At the present time no skull answering precisely to Sir Arthur Keith's description can be traced.

Remnants of presumably another fragmentary skeleton have been reported in the gravels of the Swanscombe district (Duckworth, 1913: 460). About 1912 Mr. J. Bazeley White, jun., of the firm which formerly owned the Swanscombe Cement Works, showed Dr. Duckworth parts of a human skull, with associated lower jaw and vertebrae, which were said to have been found 9 or 10 ft. down in the local gravels. The skull was of modern type, but appeared slightly distorted. The bones were of friable texture and like those of Galley Hill man showed scoring by rootlets. The present whereabouts of these remains is unknown.

The fact that human remains of recent appearance have been recorded on more than one occasion deep in the gravels of the Swanscombe district suggests that the Galley Hill skeleton may be one of a series of rather similar burials.

MORPHOLOGY OF THE SKELETON

The following remains of the skeleton have been preserved and were studied (by M.F.A.M.) in June 1948:

1. The greater part of the calvarium together with lateral and inferior parts of the brain box of the right side.
2. Three small fragments of occipital bone, one showing part of the posterior margin of the foramen magnum.
3. The right half of the mandible with chin and the two premolars and three molars *in situ*. (In some works erroneously recorded as left half of mandible.)
4. Right clavicle with acromial and sternal portions missing.
5. Three small portions of rib.
6. Portion of shaft of right humerus measuring 84·5 mm. in length.
7. Portion of shaft of left humerus measuring 235·0 mm. in length.
8. About half of right acetabulum with small portions of ischium and ilium attached.
9. About half of left acetabulum with portion of ischium.
10. About one quarter of acetabulum with portion of ischium.

11. Right femur complete except for absent greater and lesser trochanteric region. Maximum length 418·0 mm.; vertical diameter of head 33·0 mm.
12. Left femur in same state of preservation.
13. Right tibia with lower part missing as well as portion of superior articular surface; length 250·0 mm.
14. Left tibia with distal portion wanting; length 244·0 mm.

Newton (1895: 505) mentions only one humerus. 'The shaft of the humerus' is what he wrote in his enumeration. Actually the shafts of two humeri were recovered and preserved. From this list of remains it is legitimate to infer that a complete skeleton was actually present at Galley Hill, but that owing to their extreme softness and to the rather haphazard method of excavation, the other parts were lost. As a fair number of the students of the Galley Hill skeleton have pointed out since Sir John Evans originally made the remark in connexion with these remains, the occurrence of a nearly perfect skeleton is suggestive of an interment. Further evidence in support of this suggestion is to be found in the character of the breakage of the bones of the skull, and in the kind of warping which can be matched in many skulls recovered from known burials.

Considerably more of the right side of the skull, including the mandible, is present than of the left side. Furthermore, the warping or torsion of the frontal bones is markedly to the right. These facts strongly suggest that the body lay on its right side and that the weight of the superimposed earth produced the distortion to the right, as well as the greater fragmentation of the bones of the left side. Duckworth, in 1913, had already made out a strong case for the Galley Hill skeleton being a burial largely on the evidence of the distortion. In the light of the present investigation there can be little doubt that it is; moreover, evidence of antiquity is lacking.

From statements in literature it appears that there has been much misconception as regards the morphology of the skull and mandible. It has been stated, for example, that the skull is exceptionally thick, with vault varying in thickness from 10 to 12 mm. Such statements are apparently founded on the comment by Newton (1895: 506) that 'The walls of the cranium are in most parts very thick, the middle of each frontal being as much as 12 mm.' In fact, the skull bones are for the most part rather thin and far from varying from 10 to 12 mm., they vary from 3·9 to 10·0 mm. The following list presents the measurements taken of the thickness of the skull bones at definite anthropometric landmarks. The measurements were made with Ashley Montagu's sliding callipers (1937). The callipers (cranio-cephalometer) were checked for accuracy. For comparison with these measurements, similar measurements were

Landmark or region	*Galley Hill*	*American white skulls*				
At pterion (right side)	3·9	3·0	4·0	3·7	4·0	4·5
10 mm. above opisthocranion . . .	4·0	7·6	9·5	10·0	6·5	9·3
At lambda	7·1	9·4	8·0	7·9	10·0	7·6
At euryon (right side)	8·0	5·2	5·5	4·6	5·0	7·3
At bregma	8·0	7·3	6·0	5·2	6·1	7·6
At stephanion (right side)	10·0	7·4	5·0	4·9	6·7	8·0
'Middle of frontal' (Newton's measurement)	'10·0'	6·0	9·4	5·8	7·4	9·0

made on five American white skulls taken at random from a dissecting-room population. These measurements are shown opposite those of Galley Hill. All measurements are in millimetres.

If we take the measurements of the Galley Hill skull and compare them with the measurements of the American white skull in the final column, it will be seen that at pterion, above the opisthocranion, and at lambda Galley Hill has thinner bones at this region than this particular American white skull. At the four other regions Galley Hill has thicker bones, the advantage being 0·7 mm. at euryon, 0·4 mm. at bregma, 2·0 mm. at stephanion, and 1·0 mm. at 'middle of frontal'.

With the possible exception of the 2·0-mm. difference at stephanion, it will be generally agreed that these are hardly significant enough differences to justify any claims for the exceptional thickness of the Galley Hill skull bones. In brief, it is evident that the thickness of the Galley Hill skull bones falls well within the range of variation of the thickness of the skull bones of the modern white male.

The only remarkable feature of the Galley Hill skull is the rather extensive superior temporal line, but even this is well within the range of variation of modern European crania.

The 'eyebrow ridges' are of the modern bipartite form, and are not more pronounced than they are in numerous Englishmen of the present day.

According to Sir Arthur Keith (1915: 190–1; 1925: 263–4) the shape and size of the mandibular fossa, the largeness of the ear-hole, the small mastoid process, and the extensive area for the attachment of the temporal muscle are 'characters seen on the skulls of primitive races of modern type'. The shape and size of the glenoid fossa and the size of the mastoid process are well within the range of variation of contemporary Englishmen.

When I examined the skull I found the 'ear-hole' to be completely wanting. At least half of the lateral portion of the petrous bone is missing, and there remains not the least trace of the 'ear-hole', the indications being that the whole external auditory meatus and tympanic plate have been lost through partial disintegration. The loose particles of petrous bone submitted for analysis (Table II, p. 44) were insufficient to account for the part which is missing.

As regards the mandible there is no justification for claiming, as has been claimed, that in the ascending ramus a notch is almost absent. A notch is present and originally was almost certainly as deep as in contemporary man. It appears more shallow than it originally was owing to the absence of the tip of the coronoid process, and to the loss of about half of the ascending portion of the ramus and condyle. Newton's dotted-line reconstruction of these parts is inaccurate, for the base of the notch is in fact preserved.

Keith (1925: 264) states: 'The teeth themselves are not large, the total length of the crowns of the three molar teeth being 34·5 mm. The last molar is slightly longer than the second. The width of the molars . . . is less than the length.' My measurements of the length of the individual molars add up to a total length of the three crowns of 33·3 mm., but as will be seen from the following figures I found the second molar to be longer than the third molar, and the breadth of the third molar to exceed its length.

Measurements of the Right Mandibular Molars of the Galley Hill Skull

	Length	*Breadth*
M_3 . .	11·4 mm.	10·5 mm.
M_2 . .	11·4 mm.	10·0 mm.
M_1 . .	10·5 mm.	10·9 mm.

In any event, with respect to the lengths of M_2 and M_3, consultation of Table II in Gregory & Hellman (1926) will show that even in contemporary whites M_3 is frequently larger, antero-posteriorly, than M_2.

Antero-Posterior Lengths of Lower Molars 2 and 3 in which M_3 exceeds M_2 in Length

(*From Gregor & Hellman, 1926*)

	M_2	M_3
Indian	11·0	11·5
Hindu	10·1	11·5
Indians . . .	10·8	10·9
White males . . .	9·7	10·0
White females . .	8·7	9·2

These represent the minimum measurements. The averages for males were M_2 10·7, M_3 10·1; for females M_2 10·0, M_3 9·9.

The teeth show some other features which are of interest. The first and second molars present evidence of what may have been caries. The first molar presents such evidence on the antero- and postero-lingual cusps down to the root distally, while the second molar shows evidence of possible caries in the lingual wall and lingual occlusal surface of the crown. The canine tooth was lost *post mortem*. The appearance of the incisor sockets suggests that the incisors may have been lost *ante mortem*. There is evidence suggesting the presence of some inflammatory condition all the way down to the mentale, with some loss of bony tissue at the chin.

It is evident that none of the features existing in the Galley Hill remains, alone or in combination, would be difficult to duplicate in contemporary human skeletons. There are several features which are rather unusual, but these were almost certainly peculiar to this individual. For example, the right clavicle is very remarkably flattened antero-posteriorly, so that the body presents an almost quadrilateral form in cross-section. This type of flattening appears to have affected several of the long bones, the dorsal surfaces of both humeri, and the shafts of both tibiae. The femora are not markedly affected.

To conclude, then, on morphological grounds there is no reason to consider that the Galley Hill skeleton presents any primitive features whatever. So far as fossilization is concerned, the evidence is largely negative, the bones might be any Quaternary age, but in general their appearance is post-Palaeolithic rather than Palaeolithic.

RESULTS OF FLUORINE TEST

It has long been known that buried bone accumulates fluorine in course of time (Middleton, 1844). Carnot (1893) analysed a large number of fossil animal bones and teeth from various geological horizons, and showed conclusively that as a general rule their fluorine-content increased with geological age. The reason for this is now known to be that bone is partly composed of hydroxyapatite, a form of calcium phosphate which acts as a natural trap for wandering ions of fluorine, the gaseous element present in minute traces in most ground-waters. Fossil bones are rarely screened completely from a slowly moving aquatic medium, and the ultramicroscopic crystal units of the component hydroxyapatite are converted one by one into fluorapatite. This is a stable mineral, resistant to weathering, so fluorine is not readily leached after it has become fixed in bone, and on balance the proportion increases with passage of time. (There are, of course, conditions of weathering which lead to the solution of fluorapatite, but under these the bone itself would not survive.) Owing to the porosity of bone the alteration is not confined to the surface but normally proceeds more or less uniformly throughout the body of the material.

The summary figures published by Carnot, showing the proportions of fluorine characteristic of bones of different geological ages, were based on averages. So many variables are involved that it is patently impossible to date any particular bone merely by determining its fluorine-content. In one locality fluorine may be abundant in the ground-water, while in another it may be a rare trace. Thus, a Pleistocene bone from a site in a fluorine-rich region may have acquired as much fluorine as an Eocene specimen preserved in a F-deficient environment. For this reason Carnot's results have generally been regarded as interesting, but without practical application.

However, it has been pointed out (Oakley, 1948) that if one is dealing with two groups of bones from a given site or area, it should be possible in some cases to determine whether they are approximately contemporary, or whether one is significantly younger, by comparing their fluorine-contents. Such a 'fluorine test' has an obvious application where human remains have been found in a Pleistocene deposit and there is room for doubting whether they are indigenous or have been buried in the deposit in post-Pleistocene times.

With the object of exploring the possible applications of this test, Mr. R. H. Settle and his colleagues Dr. C. R. Hoskins and Mr. E. C. W. Maycock of the Department of the Government Chemist have determined the F-content of a series of minute samples of bone selected by the author. The work is still in progress, and a detailed account, including a description of the method of analysis, will be published at a later date. The results to hand are sufficient to indicate that the test is reliable for determining within broad limits the relative antiquity of bones from a given site, so long as they are preserved in permeable matrices. As expected it is not applicable to the determination of the relative antiquity of bones from widely separated sites, or from deposits of markedly different permeability. (Thus, an Early Bronze Age skeleton buried in *sand* at Walton-by-Felixstowe, in a relatively fluorine-rich area, was found to have accumulated over three times as much fluorine as the Palaeolithic skull preserved in *clay* at the Lloyd's site, London.)

The fluorine test is applicable to the Galley Hill skeleton in view of the fact (which has emerged from our review of the evidence) that the bones were embedded in a permeable matrix. The five small samples of the skeleton which are preserved in the Elliott Collection at the British Museum (Nat. Hist.) were accordingly submitted for F-determination, together with samples of twenty-two bones from various deposits in the Swanscombe region whose approximate relative ages are known. The comparative samples were carefully selected with the object of representing the greatest possible variety of conditions of preservation. The results, which are set out in Tables I and II, give striking confirmation of the conclusion that the Galley Hill skeleton, far from being Middle Pleistocene, is a comparatively recent burial. On the other hand, the known antiquity of the Swanscombe skull has been confirmed by the fluorine test (Table I, items 10–11).

It was necessary, of course, to consider the possibility that the Galley Hill bones are low in fluorine through some of their original hydroxyapatite having been replaced before F-fixation began. However, there is no evidence of ferrugination or other mineralization, and comparison of their F/P_2O_5 ratio with that of the Middle Pleistocene bones on the one hand, and of Holocene bones on the other, shows that their low F-content can be safely attributed to lack of antiquity. The following analytical figures may be taken as representative.

	F%	P_2O_5%	*Iron* (*as* Fe)%
Middle Pleistocene bones			
Sample No. 7 (S37) . . .	2·0	30	1·4
Sample No. 11 (S17) . .	*c.* 2·0	*c.* 27	*c.* 1·5
Holocene bones			
Sample No. 21 (S23) . .	0·3	28	< 0·1
Galley Hill skeleton			
Sample No. 26 (S9) . . .	0·4	27	< 0·1

It is particularly noteworthy that the ranges of F-content in the three age groups (Table I) show no overlap, in spite of the variation in conditions of preservation. Thus, in the Middle Pleistocene bones the average F-content ranges from 1·7 to 2·8 per cent.; in the Upper Pleistocene material the recorded range is 0·9 to 1·4 per cent.; and in the Holocene group 0·05 to 0·3 per cent. As one would expect, there is variation in the F-content of bones within a single deposit, and similarly between one part of a bone and another part; but the ratio of the extremes of this variation does not usually exceed 2. (The variation within an individual bone has a bearing on sampling technique which will be considered in the final report on the fluorine-dating.) If compared with a longer series of determinations, the F-content of the Galley Hill skeleton (average 0·34 per cent.) might prove to fall within the extreme limits of an Upper Pleistocene range; but already, even on the basis of comparison with a very small series of samples, it is practically accommodated by the recorded Holocene range. Thus the figures available are sufficient to indicate that while an uppermost Pleistocene date for the burial of Galley Hill man is not entirely ruled out, an early Holocene date has greater probability.

In concluding this section it is worth setting on record that on being informed of the results of the fluorine test applied to the Galley Hill skeleton, Sir Arthur Keith made the comment that they 'confirm my established doubt' (*in lit.* 22 Sept. 1948; cf. Keith, 1948: 265).

SUMMARY OF CONCLUSIONS

It has been claimed that the human skeleton found in the Middle Pleistocene gravels at Galley Hill, Swanscombe, was an indigenous fossil and therefore of Lower

TABLE I. *Comparison of Fluorine-contents of Bones from Middle Pleistocene, Upper Pleistocene, and Holocene Deposits in Swanscombe Region, Kent*

MIDDLE PLEISTOCENE BONES

Sample No.	*Description of material*	*Register No.**	*Matrix*	*Geological horizon*	*Locality*	*Fluorine* %
1. (S1)	Humerus, *Dama* cf. *clactoniana* (Falc.)	G.D. M16500	Sandy gravel	Lower Gravel, 100-ft. terrace	Barnfield pit	2·0
2. (S2)	Root of incisor, '*Cervus*' sp.	G.D. M16499	Sandy gravel	,, ,,	,,	2·8
3. (S36)	Vertebra, *Dama* cf. *clactoniana* (Falc.)	G.D. M16511	Sandy gravel	,, ,,	,,	2·1
4. (S16)	Humerus, *Felis* cf. *leo* Linn.	G.D. M16501	Loam	Lower Loam, ,,	,,	1·7
5. (S20)	Phalange, *Felis* cf. *leo* Linn.	G.D. M16502	Loam	? Lower Loam, ,,	Near Swanscombe	1·7
6. (S3)	Metapodial, *Dama* cf. *clactoniana* (Falc.)	G.D. M16510	Sandy gravel	Middle Gravels, ,,	Barnfield pit	2·3
7. (S37)	Rib, bovine	—	Loam	'Silt layer', Middle Gravels, 100-ft. terrace	,,	2·0
8. (S18)	Limb-bone, bovine?	—	Sandy gravel	'Skull level', Middle Gravels, 100-ft. terrace	,,	2·0
9. (S19)	Rolled piece of bone, indeterminate	—	Sandy gravel	,, ,,	,,	1·7
10. (S4, 5)	Occipital, *Homo* sp.	G.D. M15709	Sandy gravel	,, ,,	,,	*c.* 1·9
11. (S17)	Parietal, *Homo* sp.	G.D. M15709	Sandy gravel	,, ,,	,,	*c.* 2·0

UPPER PLEISTOCENE BONES

Sample No.	*Description of material*	*Register No.**	*Matrix*	*Geological horizon*	*Locality*	*Fluorine* %
12. (S13)	Skull, *Rhinoceros antiquitatis* Blum.	G.S.M. 4950	Chalky gravel?	'Coombe Deposits'	Baker's Hole	1·0
13. (S14)	Skull, *Rhinoceros antiquitatis* Blum.	G.S.M. 4950	Chalky gravel?	,,	,,	1·2
14. (S29)	Vertebra, *Megaceros* sp.	L.M. 49.21/1	Loam	Lowermost Loam, Ebbsfleet Series	,,	1·4
15. (S25)	Mandible, *Elephas primigenius* Blum.	L.M. 49.21/2	Chalky gravel	Above Lowermost Loam, Ebbsfleet Series	,,	0·9
16. (S31)	Limb-bone, ? *Rhinoceros* sp.	—	Loam	Temperate Bed, Ebbsfleet Series	,,	1·1
17. (S35)	Ulna, *Rhinoceros antiquitatis* Blum.	G.D. M5137	Loam	Crayford Brickearth, 50-ft. terrace	Crayford (W. of Dartford)	1·0

HOLOCENE BONES

Sample No.	*Description of material*	*Register No.**	*Source*	*Fluorine* %
18. (S12)	Root of premolar, *Ovis aries* Linn.	Z.D. 1949.3.18.1.	Soil, above gravels, Barnfield pit, Swanscombe	0·1
19. (S11)	Skull, *Homo sapiens* Linn.	Marston Coll.	Under collapsed Thanet Sand (dene-hole?), Kemsey's pit, Swanscombe	0·1
20. (S22)	Skull, *Homo sapiens* Linn.	Z.D. 1949.3.9.2.	Chalky soil, Bevan's Works, Northfleet	0·2
21. (S23)	Skull, *Homo sapiens* Linn.	Z.D. 1949.3.9.1.	Chalky soil (said to contain Romano-British pottery), Bevan's Works, Northfleet	0·3
22. (S38)	Tibia, *Homo sapiens* Linn.	Gravesend Library Coll.	Saxon grave, 3 ft. deep in gravel, Northfleet	0·05

TABLE II. *Fluorine-content of the Galley Hill Skeleton*

Sample No.	*Description of material*	*Register No.**	*Matrix*	*Fluorine* %
23. (S36)	Petrous bone of skull	G.D. E1359	Gravelly sand and loam	0·3
24. (S7)	Cancellar tissue of mandible	G.D. E1360	,,	0·4
25. (S8)	Right tibia	G.D. E1363	,,	0·4
26. (S9)	Loose fragment of limb-bone	G.D. E1362	,,	0·4
27. (S10)	Left femur	G.D. E1361	,,	0·2

* Key to register numbers: G.D. = Geology Department, British Museum (Nat. Hist.); G.S.M. = Geological Survey Museum; L.M. = London Museum; Marston Coll. = Mr. A. T. Marston's private collection; Z.D. = Zoology Department (Osteology), British Museum (Nat. Hist.). (Unregistered fragmentary bones were used when the matrix and horizon were certain.)

Palaeolithic (Acheulian) age. The skull has been described as showing primitive features conformable with great antiquity.

From the statements of some authors it might appear that the skull is exceptionally thick, but re-measurement has shown that the bones are well within the range of variation found in modern whites, and at some points unusually thin. The eyebrow ridges are not more pronounced than in many Englishmen of the present day. It has been stated that the mandible is of primitive type, and that the sigmoid notch is almost missing. Re-examination has revealed no primitive features; the shallow appearance of the notch is due to the loss of the tip of the coronoid process and of the posterior half of the ascending ramus.

Even the most fragmentary skeletal remains of Palaeolithic man are excessively rare in fluviatile deposits. With the exception of deliberate burials (and the earliest of these are Upper Pleistocene) the association of the skull and limb-bones of a single individual has not hitherto been recorded in undoubted river gravels anywhere in the world. The published claims that this skeleton was indigenous rest on negative evidence. The collector declared that the overlying beds showed no signs of having been disturbed; but by the time he examined the section evidence of burial would have been largely—perhaps entirely—removed by the workman digging the gravel. Some accounts of the discovery give the impression that the bones were contained by a definite horizontal seam of loam within the gravels, but the indications are that their actual matrix was of a mixed character.

Wherever the Swanscombe gravels have been protected from intensive decalcification, as in the neighbouring Barnfield pit, they have yielded numerous fragmentary animal remains. However, in the Galley Hill pit the gravels and intercalated loams have been almost completely decalcified, and so far as is known have never yielded any fossil animal bones or shells. The preservation of the human skeleton (which, it is important to note, was in a permeable matrix) is only accountable as an interment subsequent to the decalcification of the deposits. Traces of two apparently similar burials in the Swanscombe gravels are on record.

The fluorine-content of bones increases with geological age. Comparison of the F-content of the Galley Hill skeleton with that of twenty-two bones of known relative ages from various deposits in the same district confirms the conclusion that it was not indigenous to the Middle Pleistocene gravels in which it lay, but a burial of later date—prehistoric, but probably post-Pleistocene.

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PLATE 4

THE GALLEY HILL SITE

A. The Galley Hill pit: south side viewed from Pilgrims' Road, looking SW., in November 1948. The site of the skeleton is indicated by *S* on the Chalk shelf to the right of the school buildings. Cf. Fig. 3.

B. Section close to the site showing stratified river gravel on an irregular surface of Chalk. The hand-pick (length 1 ft. 5 in.) is at junction of disturbed and undisturbed gravel, not readily defined.

A

B

THE GALLEY HILL SITE